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It's no secret that emissions markets

have come a long way and that the cap-and-trade concept has enabled a revolution of sorts in compliance alternatives and risk management strategies. But what may surprise some readers is just how sophisticated today's sulfur dioxide (SO₂) and nitrogen oxides (NO_x) allowance markets are and what that means for upcoming implementation of the Clean Air Interstate Rule (CAIR) and beyond.

The cap-and-trade mechanism is increasingly embraced domestically and internationally as an efficient, effective, and proven approach for reducing air pollution emissions. While familiar with the concept of cap-and-trade programs, many air quality professionals may be surprised by the evolution and sophistication of the markets that operate within them. A look at the market activity in two well-established programs provides a fascinating window into the many opportunities and strategies that have arisen from the compliance flexibility and economic motivation provided by the cap-and-trade mechanism. Allowance markets are but a secondary feature to the environmental accountability and results that are the driving force of these programs, but an important one nonetheless.

A cap-and-trade program sets a cap, or maximum limit, on emissions to achieve broad, regional reductions. Regulated sources are allocated emissions allowances within the cap. Individual control requirements are not specified, but each

source must surrender allowances equal to its actual emissions for compliance. The cap ensures that environmental goals are achieved, while providing flexibility to sources, and stability and predictability to the allowance trading market.

The cap-and-trade mechanism does not replace the requirement to meet the National Ambient Air Quality Standards (NAAQS) at the local level, but rather helps achieve those standards through significant reductions in pollution transported across state boundaries. State and local governments may impose additional source-specific emissions limits, as warranted.

**Cap-and-trade programs have
reduced emissions faster and at far
lower costs than anticipated.**

The now-familiar Acid Rain Program was the first nationwide experience with the cap-and-trade concept in the United States. Created under Title IV of the 1990 Clean Air Act (CAA) Amendments, the Acid Rain Program was charged with achieving the vast majority of the CAA's required 10-million-ton reduction in nationwide power plant SO₂ emissions, beginning in 1995. Since 1999, the cap-and-trade mechanism has also been used to reduce NO_x emissions from power plants and other large combustion sources in the eastern United States, first through the Ozone Transport Commission's NO_x Budget Program and more recently through the NO_x SIP Call's NO_x Budget Trading Program.

POSITIVE ENVIRONMENTAL RESULTS

The Acid Rain and NO_x Budget Programs have reduced SO₂ and NO_x emissions faster and at far lower costs than anticipated, yielding wide-ranging health and environmental improvements. SO₂ emissions from power plants have decreased by more than 7 million tons, compared to 1980 levels (a 41% reduction), and the greatest reductions have been achieved in the areas of highest emissions. For example, wet sulfate deposition has decreased 36% in the Northeast and 32% in the Midwest since 1990, and ambient concentrations of SO₂ have decreased by as much as 40% in the Northeast and Mid-Atlantic since 1990. A 2005 study reported in the *Journal of Environmental Management* concluded that in 2010, "because of Title IV, about 23 million more people can be expected to be living in counties meeting the [fine particulate matter] PM_{2.5} NAAQS."¹

In 2005, NO_x emissions during the summer ozone season were 57% lower than in 2000, resulting in measurable decreased average ozone levels in the NO_x Budget Trading Program region. Based on 2003–2005 air monitoring data, ozone air quality improved in all 103 areas designated non-attainment in 2004. In fact, nearly 70% of these areas now have air quality that is better than the standard. Remarkably, these emissions reductions occurred while electrical generation increased significantly (see Figure 1), and the

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benefits have coincided with substantial cost savings. The *Journal of Environmental Management* study noted that the benefits from the Acid Rain Program in 2010 would be US\$122 billion annually, against costs of around US\$3 billion (for both the SO₂ and the more traditional NO_x programs).¹

Compliance with the programs has been consistent and extraordinarily high (over 99%), thanks in part to stringent penalty provisions, including the requirement to surrender future allowances to offset any excess emissions. While there have been some minor cases of noncompliance, mostly due to corporate accounting errors, the environmental integrity of the caps have never been compromised. Additionally, rigorous emissions monitoring and reporting requirements ensure complete accountability, as well as high-quality, transparent, and readily accessible emissions information (see www.epa.gov/airmarkets). While a large bank of allowances resulting from early over-compliance may mean a delay in the ultimate achievement of program goals, the early reductions these allowances represent have delivered critical benefits far sooner than required or expected.

Finally, the U.S. Environmental Protection Agency (EPA) and others have analyzed potential local impacts from cap-and-trade programs and found that trading has not resulted in localized high emissions or geographic shifting of emissions. To the contrary, the highest emitting sources have tended to reduce emissions by the greatest amount.

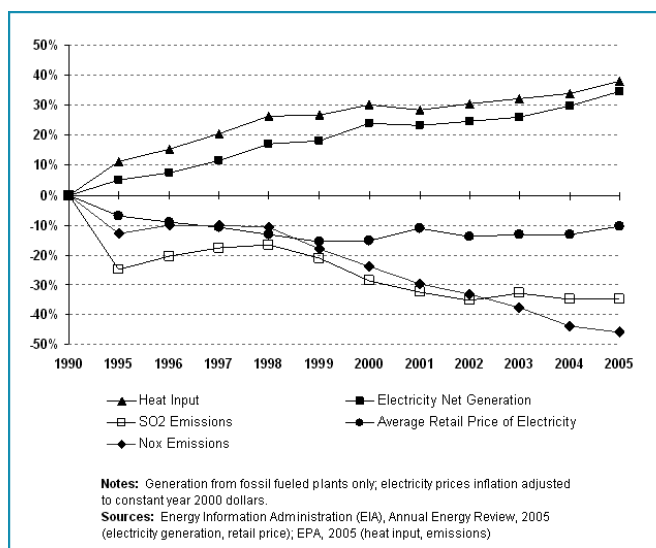


Figure 1. Trends in electricity generation, fossil energy use, prices, and emissions from the electric power industry.

ALLOWANCE MARKET TRANSACTIONS AND STRUCTURES

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to comply by installing controls with little or no reliance on these markets, the markets offer numerous opportunities to reduce costs, manage risk, and even turn a profit.

In the early years of the SO₂ market, in addition to active “spot” and “forward” markets, many transactions were “swaps,” whereby allowances of different vintages were exchanged between parties. Also common was the bundling of allowances and fuel in a single contract. As the market began to mature, the spot (or cash) market expanded, as illustrated by the private transfer volumes in Figures 2 and 3. Both programs also saw increases in transactions between economically distinct entities over time, which provide a strong indicator of true market activity. In 2005, 30% of the transfers in the NO_x market and 50% of the transfers in the SO₂ market were economically significant (i.e., between economically distinct, or unrelated, organizations).

As participants grew in number and experience, activity moved beyond immediate settlement transactions to offer more flexibility and opportunities for risk management, including additional options and forward contracts. Options give the buyer the right to purchase allowances at a certain price by a certain date. Options provide a way to hedge risk against price fluctuations, but may also be used to maximize revenue on a portfolio of allowances.² Forward contracts enable a purchaser to contractually agree to buy a number of allowances for delivery in the future at an agreed upon price, providing buyers with

long-term planning capability and certainty.

Another indicator of the strength of the market has been the creation of futures exchanges. Both the Chicago Climate Futures Exchange (CCFE) and New York Mercantile Exchange (NYMEX) operate SO₂ and NO_x futures markets. Futures markets have two central roles: risk transfer and price discovery.³ The principal difference between futures and forwards is that forwards are over-the-counter transactions, whereas futures are backed by financial exchanges and, therefore, are standardized and financially guaranteed. According to Pete Zaborowsky, managing director of Evolution Markets, which specializes in structuring transactions and providing consulting services for environmental credit markets, these exchanges have thus far proven important in providing clearing services to the market. For example, a party will perform an over-the-counter trade with a broker, and then clear it on CCFE or NYMEX when the parties cannot deal with each other directly due to credit issues.

For all of these mechanisms, allowance prices are fluid and price information is readily available from a variety of sources. Private sector firms have stepped in to provide price indices for both the SO₂ and NO_x markets, which offer important information in structuring transactions. For example, there are a growing number of financially settled transactions, in which parties never exchange allowances, but settle only for cash differences against a price index.

ALLOWANCE MARKET PLAYERS

The early market generally saw trading only among power plants, often supported by emissions brokers, who have played an important role in facilitating market activity. Power plants received allowance allocations by virtue of owning generating facilities covered by the program and also had the obligation to hold sufficient allowances to cover emissions. To balance their positions, sources that were “short” (defined here as firms that received too few allowances to cover their expected emissions) entered the market as buyers. Sources that were “long” (defined here as firms that held more allowances than needed to cover their emissions obligation) entered the market as sellers.

It did not take long for this early trading to be supplemented by three additional sources of activity. First, many power companies ran trading operations, which, even though they had no direct requirement to hold allowances, entered the market to pursue arbitrage opportunities. Second, as companies became more comfortable working in these new markets, they started to use hedging strategies to better manage their allowance portfolios. Third, several firms that operated specialized trading operations, but did not own generating sources, entered the market to seek arbitrage opportunities. Hedging and arbitrage (or speculation, as it is sometimes referred) are both normal and necessary parts of the market.

The most recent entrants into the emissions allowance marketplace have been hedge funds, investment banks, and insurance companies. Following patterns seen in the broader energy marketplace, hedge funds such as Tyticus, Centaurus Energy, and Saracen; investment banking firms such as JP Morgan; and insurance companies such as Swiss Re, have

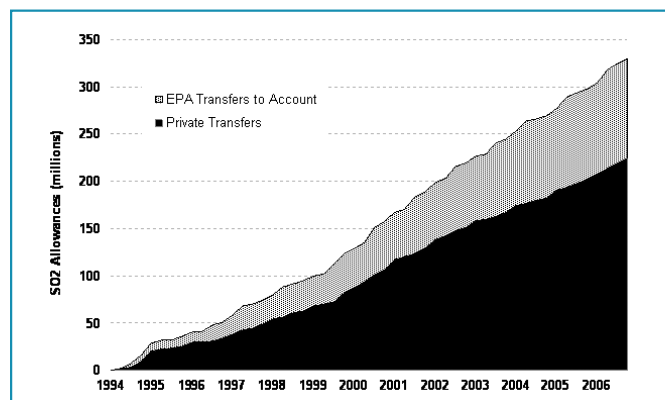


Figure 2. Cumulative SO₂ allowances transferred through 2006.

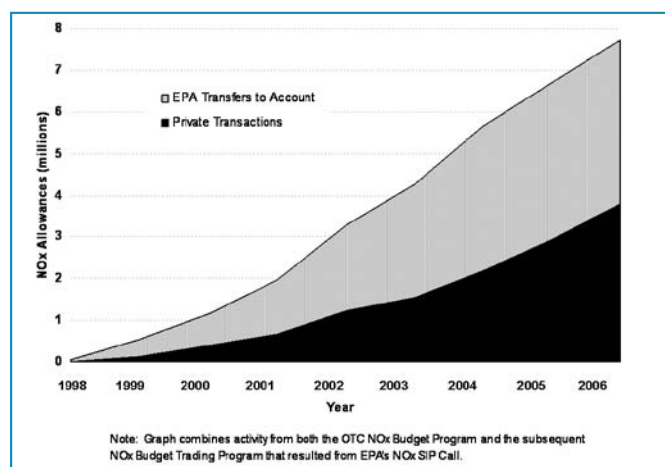


Figure 3. Cumulative NO_x allowances transferred through 2006.

begun taking positions in emission allowances. These firms help increase trading activity and efficiency.

THE NEXT PHASE OF SO₂ AND NO_x MARKETS

In 2005, EPA finalized the Clean Air Interstate Rule (CAIR), which requires further SO₂ and NO_x reductions in many eastern states, as part of the PM_{2.5} and ozone NAAQS control strategies. The expansion of the NO_x program in 2009 and the continuation of the SO₂ program with the addition of a tighter, regional cap in 2010 set the stage for additional emissions reductions and the expansion of cap-and-trade markets. All 29 CAIR-affected jurisdictions are expected to participate in the EPA-administered trading program. The power industry is actively installing pollution controls and making other compliance preparations, and the effects are already becoming evident in the current trading markets.

Estimates of future control costs impact the current market price of SO₂ allowances, since allowances are bankable today for use in future years (e.g., sources will use Title IV SO₂ allowances to demonstrate compliance with CAIR as well as Title IV). SO₂ allowance prices averaged US\$480/ton at the end of February 2007 (see Figure 4), but market observers generally agree that today's SO₂ allowances are undervalued. According to Zaborowsky, this stems at least in part from the fact that the power

sector is largely on the sidelines finalizing their CAIR compliance plans.

Modeling conducted by EPA for the promulgation of CAIR projected that pre-2010 vintage SO₂ allowances would be worth US\$736 per allowance in 2010 (\$2007), and that 2010–2014 vintage allowances would be worth approximately US\$368 per allowance due to the 2:1 retirement ratio that applies to those vintage allowances for sources in the CAIR region. (Note: Under CAIR, SO₂ allowances of vintage

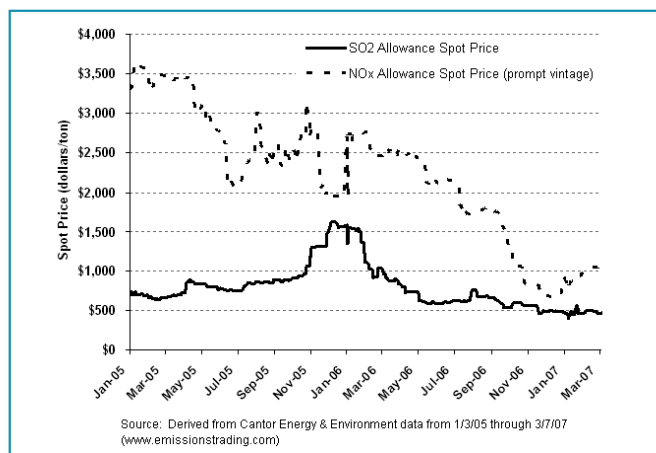
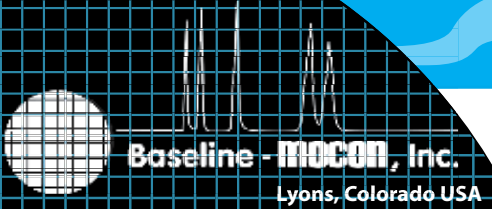


Figure 4. SO₂ and NO_x allowance spot prices.

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A GLOSSARY OF TERMS

Allowance: The term generally used to refer to the emissions reduction unit traded in emissions trading programs; in the Acid Rain Program this term specifically means the limited authorization to emit one ton of SO₂ during a given year.*

Broker: The person who acts as an intermediary between a buyer and a seller, usually charging a commission.*

Bundling: A contract structure that involves more than one commodity. In the emissions markets, producers of high sulfur coal have bundled allowances with a coal contract to allow companies that burn the higher sulfur coal to meet the compliance requirements of the Acid Rain Program.*

Financial Settlement: A transaction where a physical commodity, such as allowances, never changes hands. Instead parties settle only for cash differences, usually against a price index.*

Forward Settlement: The purchase or sale of a specific quantity of allowances at the current or spot price, with delivery and settlement scheduled for a specified future date.*

Futures Contract: A legally binding agreement, made on the trading floor of a futures exchange, to buy or sell a commodity or financial instrument sometime in the future. Futures contracts are standardized according to the quality, quantity, delivery time, and location for each commodity. The only variable is price, which is discovered on an exchange trading floor.**

Options Contract: A contractual right, but not an obligation, to buy or sell allowances at an agreed price; the option buyer pays a premium for this right. If the option is not exercised after a specified period, it expires.*

Over-the-Counter: A market in which allowance transactions are conducted through the direction interaction of counterparties rather than on the floor of an exchange.*

Spot Market: This usually refers to a cash market price for a physical commodity that is available for immediate delivery.**

Swap: An exchange of one allowance for another to exchange the vintage years of the allowances held in accounts.*

* Definition from the Emissions Trading Education Initiative (ETEI, www.etei.org)

** Definition from the Chicago Board of Trade glossary, www.cbot.com/cbot/pub/page/0,3181,1059,00.html.

2009 and earlier will each cover one ton of emissions; vintage 2010–2014 allowances authorize 0.50 tons of emissions; vintage 2015 or later allowances authorize 0.35 tons of emissions.) Observers note that in the coming years, the market is likely to see more swaps of pre-2010 SO₂ allowances with later vintages and more futures activity.

CAIR also impacts the NO_x markets, creating two programs beginning in 2009: an annual NO_x reduction as part of the PM_{2.5} NAAQS control strategy, and a seasonal NO_x reduction for ozone control. While there will be two distinct markets, EPA expects that the prices in both markets will be established by the cost of controls for annual compliance. Others, like Thaddeus Huetteman of Power and Energy Analytic Resources, which provides consulting and engineering services for the power industry, think risk will also play a significant role in price determination, and that seasonal allowances may initially be more costly given the higher perceived risk in the seasonal market.

There have already been some trades of 2009 seasonal NO_x allowances that help begin the price discovery process for the transition to CAIR, but allowances for the new, annual NO_x CAIR market have not begun to trade yet. EPA's modeling projects annual NO_x prices in 2010 of approximately US\$1440 per ton. The trends that will emerge under the new dynamic of dual annual and seasonal NO_x markets are not yet clear. For both markets, it will take time for buyers and sellers to assess the fundamentals of the changes introduced by CAIR. Regardless of the level and type of activity that evolves, however, the environmental result will be achieved, and that is the true measure of success.

CONCLUSIONS

Experience with the Acid Rain and NO_x Budget Trading Programs demonstrates that cap-and-trade programs are an effective means of achieving broad improvements in air quality. Results demonstrate that the combination of mandatory emissions caps, a viable allowance trading market, rigorous emissions monitoring and reporting protocols, and automatic enforcement provide accountability and ensure results in a cost-effective manner. The market developments discussed in this article demonstrate a successful environmental partnership. With a government focused on results and a private sector motivated to innovate, cap-and-trade systems deliver environmental results as efficiently and effectively as possible. **em**

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